

Space Weather Technical Forecast

Issued on Friday, 31 March 2023 at 00:27 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of both Minor Radio Blackouts and Minor Geomagnetic Storms.**Analysis of Space Weather Activity over past 24 hours**

Solar Activity: Solar activity has been Moderate over the past 24 hours, with a M5.4 at 30/0737UTC from AR3256. This region was the largest and most active on the visible disc, but is now very close to the western limb and has rapidly decayed. The M5 flare produced Type II and IV radio bursts, with the former associated with an estimated speed of 369km/s. The resulting Coronal Mass Ejection (CME) was analysed and misses Earth.

The remaining five numbered regions are much smaller and simpler, with only AR3262 showing any growth in developing some trailing spots to the south of the main penumbral group. A small CME from near the solar equator around 40W at 30/0720UTC has been analysed and is not considered to be Earth directed. A previous CME, which was emitted from a prominence eruption on the southeast limb around 29/1200 UTC, has been re-analysed. There is now a low confidence potential glancing blow to Earth early on the 3rd April.

Solar Wind / Geomagnetic Activity: The solar wind, as measured at L1 by DSCOVR, started the UTC day having just experienced a weak CIR from the HSS from CH88/-. Through the morning the solar wind was at slightly elevated speeds, then increased early afternoon to become elevated, peaking at 592 km/s at 30/2027 UTC.

The solar wind density was initially below average, then increased to reach above average values late morning, peaking at 15 ppcc at 30/1154 UTC. After this the density rapidly decreased to below average levels. The IMF was predominantly weak, but occasionally touched moderate levels, peaking at 10 nT at 30/1217 UTC. The Bz component was mostly weakly negative and so anti-aligned with Earth's field, reaching -7 nT at 30-/1421 UTC. The phi angle was negative (towards the Sun) throughout.

The net result was for Quiet to Unsettled (Kp 2-3) geomagnetic activity, with one isolated G1/Minor Storm period (Kp 5) 30/1800-2100 UTC.

Energetic Particles / Solar Radiation: A slight high energy proton enhancement (greater than 10MeV) was visible at GOES16 as a result of the M5.4 flare, with 10MeV protons peaking at roughly half a pfu by mid-morning UTC (where S1 is 10pfu). After this the high energy protons declined to end the period at background levels.

The high energy electron flux (greater than 2MeV), as measured at GOES16 fell from High to Normal Background, peaking at 1.8e3 at 30/0015 UTC. The associated 24-hour fluence started above the Active (1e8 integrated pfu) threshold, but then steadily declined through the day, recording 3.25e7 integrated pfu at 31/0001UTC.

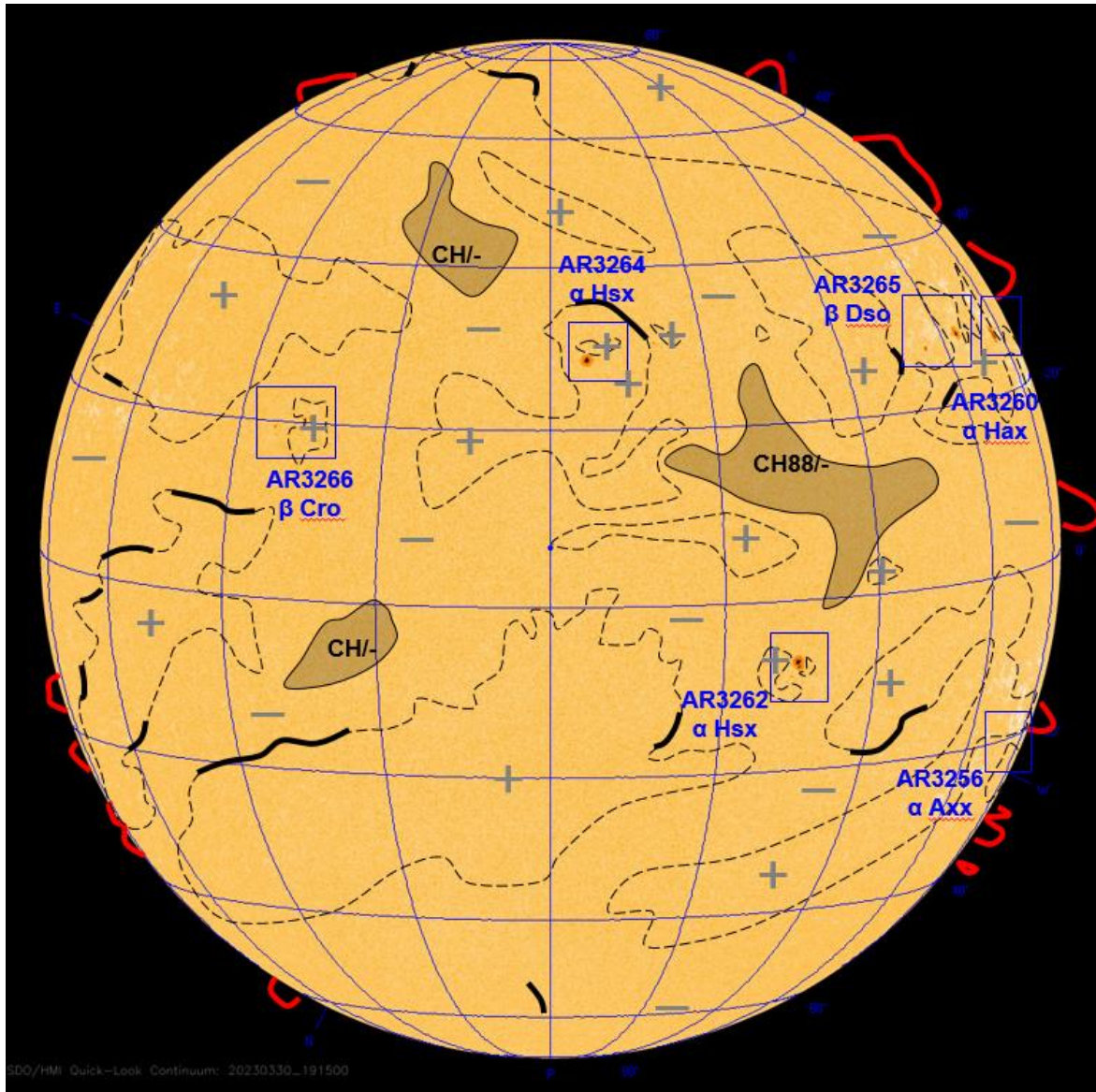
Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity carries an initial Chance of further M-class flares in the next 24 hours or so, most likely from AR3256 approaching the southwest limb. The risk of further such events then declines as the region rotates further away behind the west limb.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs currently feature in the forecast, apart for a low confidence glancing blow from a CME early on the 3rd April. Earth is currently within the HSS from CH88, with elevated speeds. The solar wind is expected to remain at elevated levels until late day 3 (2nd), then decline to become slightly elevated. Geomagnetic activity is expected to be mainly Unsettled to Active (Kp 3-4) today and tomorrow (31st and 1st), with a chance of isolated G1/Minor geomagnetic storm intervals (Kp 5). After this a decline to Quiet to Unsettled conditions (Kp 1-3) are expected, with only a chance of Active intervals early on the 3rd with the potential CME arrival.

Energetic Particles / Solar Radiation: High energy (greater than 10MeV) proton flux carries a Slight Chance of breaching S1 given the slight enhancement yesterday, and the prospect of the active region responsible remaining in a geoeffective location for the start of the forecast period. The high energy (greater than 2 MeV) electron flux is expected to remain below the High threshold (1e3 pfu), but under the influence of the HSS from CH88, and also diminishing geomagnetic activity later in the period, the flux is likely to breach the High threshold again from late day 2 (1st), becoming predominantly high for day 4 (3rd) The corresponding 24-hour fluence will therefore increase later in the period, and is expected to breach the Active threshold by the end of the period.

Figure 1. Solar Analysis Valid 30/1915 UTC.



Key: Filament — , Prominence — , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-γ-δ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

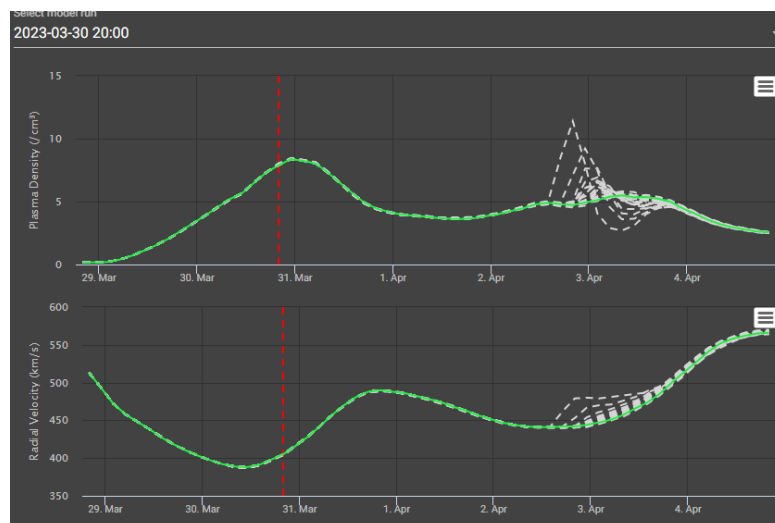
No Earth-directed CMEs currently feature in the forecast, apart for a low confidence glancing blow from a CME early on the 3rd April. This was from the prominence eruption from the southeast limb on the 29th.

Earth is currently within the HSS from CH88/-, with elevated speeds. The solar wind is expected to remain at elevated levels until late day 3 (2nd), then decline to become slightly elevated.

Geomagnetic activity is expected to be mainly Unsettled to Active (Kp 3-4) today and tomorrow (31st and 1st), with a chance of isolated G1/Minor geomagnetic storm intervals (Kp 5). Any G1/Minor storm intervals are most likely early today and then during the coming UTC night. During day 3 (2nd) a decline to Quiet to Unsettled conditions (Kp 1-3) is expected, with only a chance of Active (kp 4) intervals early on the 3rd with the potential CME arrival. However, confidence is very low for the CME arrival, with only a few of the MOSWOC Enlil ensemble members showing a slight perturbation in the density and solar wind speed associated with the CME.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	Yes	50	20	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Met Office Enlil ensemble



Radio Blackouts - X-Ray Flares:

There are currently six numbered sunspot regions on the disc, with AR3257 and AR3263 both fading to plage. AR3256, which has been historically the largest, most complex and active region has been recently downgraded to a simple Axx/Alpha group, as the leading section of the region has now reached the west limb and so is not visible. The trailing section of the region has rapidly weakened over the past few hours to a few small and faint spots, and is close to becoming plage. The remaining regions are all small, weak and magnetically simple, with only slight changes.

Up to six past regions may return from the far side during the four-day period, therefore potentially the probabilities of significant flares may increase.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	25	15	5	1
Very Active	R3 to R5 X Class	No	10	5	1	1

Solar Radiation Storms - (High Energy Protons):

As AR3256 remains in a geoeffective location for the start of the forecast period so there is a slight chance of a S1 event occurring, but this decreases by the end of the period as AR3256 rotates further behind the west limb.

Radiation Storms	Level (cm ⁻² sr ⁻¹ s ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	10	10	5	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = cm⁻²sr⁻¹s⁻¹)

High Energy Electrons Event (≥ 2MeV):

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The high energy (greater than 2 MeV) electron flux is expected to remain below the High threshold (1e3 pfu), but under the influence of the HSS from CH88, and also diminishing geomagnetic activity later in the period, the flux is likely to breach the High threshold again from late day 2 (1st), becoming predominantly high for day 4 (3rd)

The corresponding 24-hour fluence will therefore increase later in the period, and is expected to breach the Active threshold by the end of the period. The MOSWOC REFM model is considering to be offering reasonable guidance, with an acceptable trend.

GEO Electron Environment	Level (cm ⁻² sr ⁻¹ day ⁻¹)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	Yes	30	50	70	80
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	5

Figure 3: Met Office REFM model.

